Intel® Smart Sound Technology Driver

Bring Up Guide

Revision 1.7

February 2021

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Revision History

Document Number	Revision Number	Description	Revision Date
613171	1.0	• Initial release	June 2019
	1.1	• Updated BIOS Configuration for USB/BT audio enable. • Updated Audio DSP Features Check for USB/BT audio offload. • Added additional statement for device class code.	August 2019
	1.2	• Updated Section 1.2 on Acronyms and Terminology and reference document. • Updated picture of SST architecture. • Added description into Section 2.3 For Audio Codec Selection and External NHLT settings. • Included the BT audio configuration in Chapter 3 NHLT and DMIC Blob Integration. • Added description of BT and UAOL driver installation into Section 4.1. • Added endpoint descriptor check in Device Manager in Section 5.4 to Section 5.7.	November 2019
	1.3	• Added Section 5.8 on Multi-Voice Assistant and Section 2.3 on MVA BIOS configuration. • Updated Section 5.6 on USB Audio offload screenshot. • Added RVP default NHLT as sample for NHLT generation.	March 2020
	1.4	• Updated Section 1.3 with Ref005,006, and 007. • Added Section 5.5 on BT* Audio offload GPIO pin configuration. • Updated Section 5.6 USB audio offload.	May 2020
	1.5	• Added MVA ext inf certified standalone information in Section 5.8 • Added suggestion to install GFX before SST driver for TGL 20H1 system in Section 4.1 • Removed "Install SST before GFX" from Chapter 7	September 2020
	1.6	• Updated Section 1.3 • Added Chapter 6 for -26dBFS MIC sensitivity calibration	December 2020
	1.7	• Updated Section 1.3 reference documents • Updated Section 5.8 on MVA	February 2021

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1 Introduction

1.1 Purpose and Scope of Document

This document provides installation instructions and general usage guidance for Intel® Smart Sound Technology (Intel® SST) Driver (formerly Audio DSP Driver).

The Intel® Smart Sound Technology Driver supports Alder Lake(ADL), Coffee Lake (CFL), Cannon Lake (CNL), Comet Lake (CML), Ice Lake (ICL), Jasper Lake(JSL), Rocket Lake(RKL), Tiger Lake(TGL) and Whiskey Lake (WHL) platforms with Intel audio DSP integrated on Windows* 10 64-bit Operating Systems.

1.2 Acronyms and Terminology

Term	Description
ADL	Alder Lake
ACPI	Advanced Configuration and Power Interface
BIOS	Basic Input/Output System
BKC	Best Known Configuration
BT	Bluetooth*
CFL	Coffee Lake
CML	Comet Lake
CNL	Cannon Lake
CS	Connected-Standby (Instant Go)
CRB	Customer Reference Board
DMIC	Digital Microphone
DSP	Digital Signal Processing
EVAD	External Voice Activity Detection
FW	Firmware
Gfx	Graphics
HDA or HD-Audio	High Definition Audio
I2S	Inter-IC Sound, A data interface

Term	Description
ICL	Ice Lake
IHV	Independent Hardware Vendor
Intel® OED or OED	Intel® Offload Engine Driver
Intel® SST	Intel® Smart Sound Technology
Intel® WOV	Intel® Wake on Voice. (Old name: LPAL, Low Power Always Listening)
ISV	Independent Software Vendor
JSL	Jasper Lake
LP	Low Power
MCP	Multi-Chip Package
MSFT	Microsoft* Corporation
NHLT	Non-HD-Audio Link Table
Non-CS	Non-Connected-Standby (Non-Instant Go)
OS	Operating System
PCH	Platform Controller Hub
RKL	Rocket Lake
RVP	Reference Validation Platform
SDW/SNDW	SoundWire*
SUT	System Under Test
TBD	To be determined
TGL	Tiger Lake
UAA	Universal Audio Architecture
UAOL	USB Audio Offload
ULT	Ultra-Thin
VAD	Voice Activity Detection
WHL	Whiskey Lake

1.3 Related Documents and References

ID	Document Number	Document Title
Ref001	613651	Intel® Smart Sound Technology Validation and Debug Guide
Ref002	610730	Intel® Wireless Technical Advisory: Bluetooth* Audio Offload
Ref003	599433	DMIC Blob and Geometry Integration Steps in SIC User Guide
Ref004	microphone-array-geometry-descriptor-format	Microphone Array Geometry Descriptor Format
Ref005	620882	Intel® Smart Sound Technology ISV/IHV Enabling Tutorial User Guide
Ref006	620544	Intel® Smart Sound Technology Multi-Voice Assistant (MVA) Enabling Dashboard
Ref007	571948	Audio, Voice, and Speech System Implementation Design Guide
Ref008	595819	Intel® Speech Platform Evaluation Toolset Test Guide
Ref009	598645	Intel® Smart Sound Technology (Intel® SST) Customer Enabling Update Technical Advisory
Ref010	630235	Intel® Smart Sound Technology Acoustic Context Awareness Bring Up Guide
Ref011	632541	Intel® Smart Sound Technology Audio Firmware Signing and Manifesting User Guide
Ref012	634270	Intel® Smart Sound Technical Advisory: USB Audio Offload
Ref013	631659	USB Audio Offload (UAOL) Disable
Ref014	633107	Audio Processing Object (APO) Support on Bluetooth* and USB Offload Endpoints Technical White Paper
Ref015	633975	Intel® Smart Sound Technology – Audio Processing on USB and Bluetooth* Offload Endpoint Guidance
Ref016	567977	Intel® Smart Sound Technology Codec Function Driver Developers Guide
Ref017	543799	Intel® Smart Sound Technology Offload Engine Application Programming Interface Specification
Ref018	632502	Intel® Wake on Voice (Intel® WoV) – Customer Data Requirement Specification
Ref019	632913	Intel® Smart Sound Technology (Intel® SST) Codec Function Driver Hybrid DSP Support Requirements Specification

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2 Platform Details

2.1 Audio Subsystem Overview

Intel® Smart Sound Technology (Intel® SST) supports HD-Audio codecs connected to designs based on Tiger Lake (TGL), Cannon Lake (CNL), Coffee Lake (CFL), Comet Lake (CML), Ice Lake (ICL), and Whiskey Lake (WHL) Platform. Intel® SST is supported both on Connected Standby and Non-Connected Standby platforms. The Audio DSP in the HD-Audio controller controls both the HD-Audio codec and the audio on the Display Port and HDMI interfaces. This HD-Audio link for the audio codec supports multiple voltages (1.5 V/1.8 V/3.3 V).

Audio DSP in the HD-Audio controller meets the Microsoft* UAA compliancy. With DSP integrated into the PCH, the offloaded audio goes through multi-layer audio processing inside the DSP with the Intel® SST FW loaded.

Note: Be aware of all Intel® SST features available on Standard (non-InstantGo*) platforms. Intel® WOV saves power while in S0 — but currently cannot wake a system while in S3 on the Standard (non-Instant Go*) platforms.

Figure 2-1. Audio System

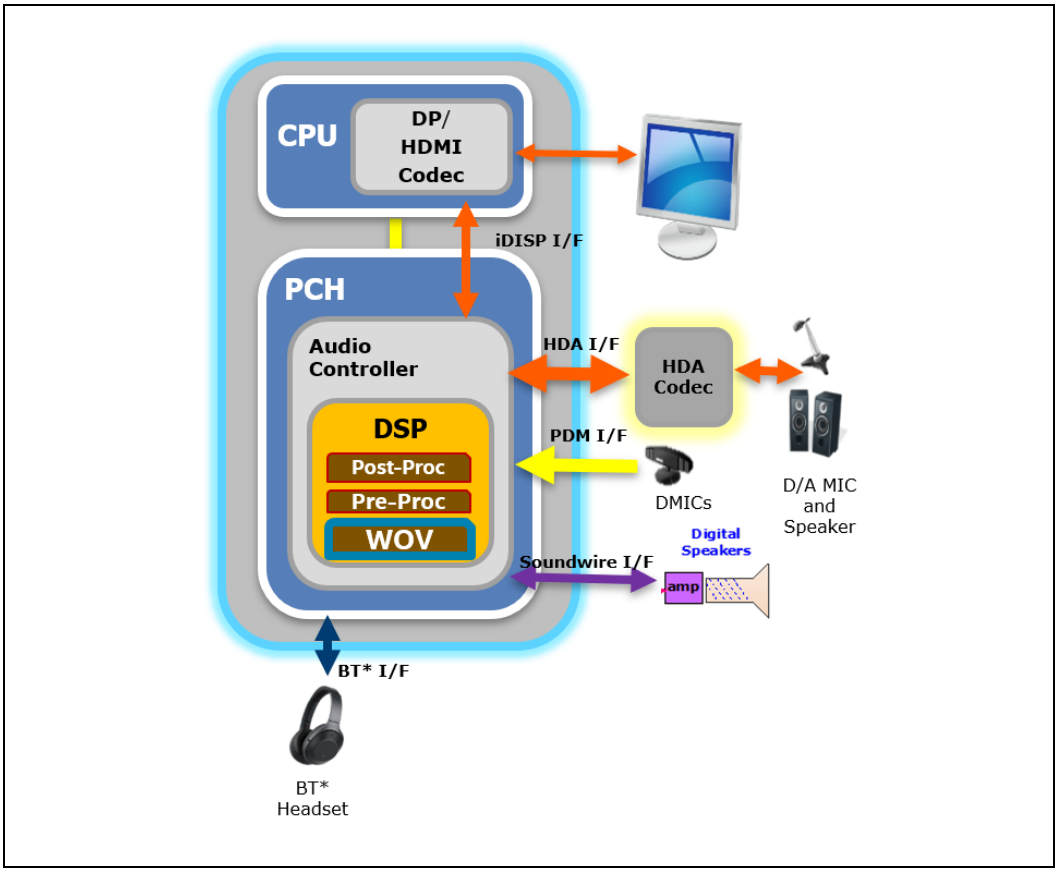


Figure 2-2. SoundWire*-Based Smart AMP

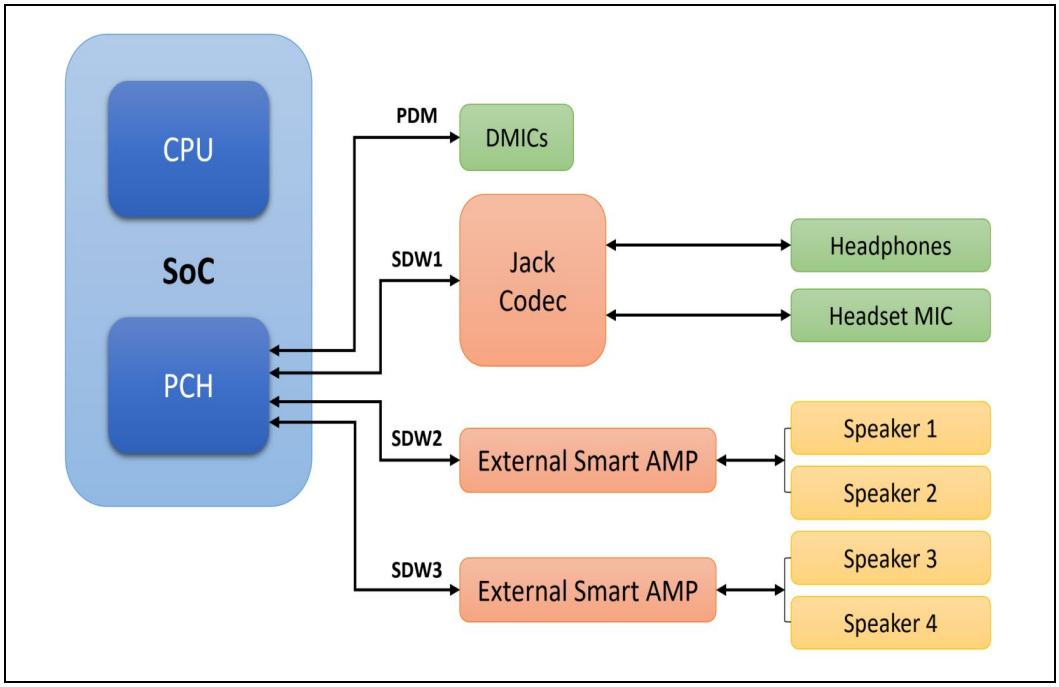
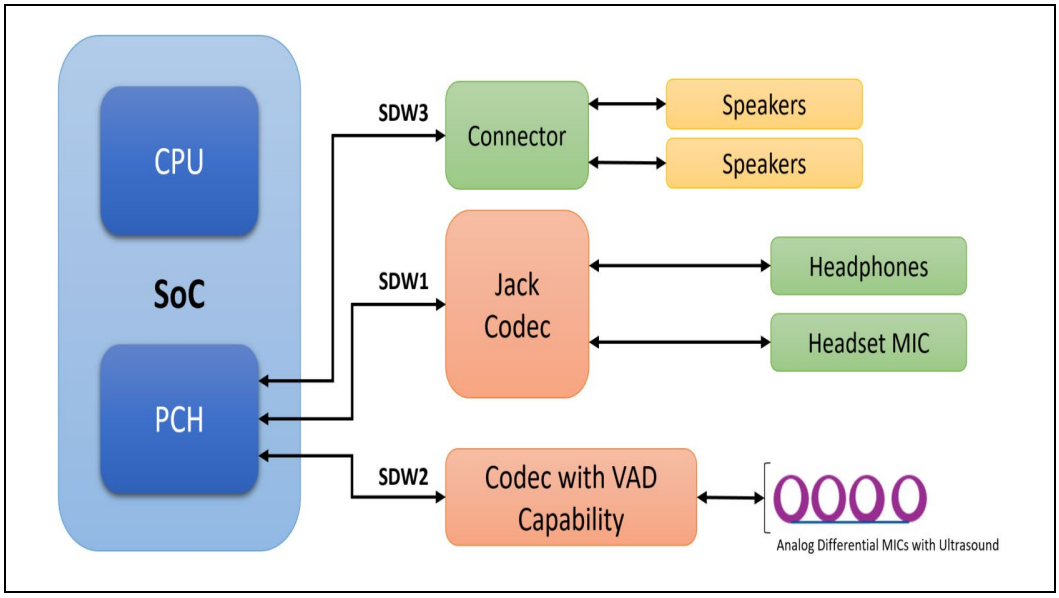


Figure 2-3. Intel® WOV with SoundWire*-Based External VAD



2.2 System Configuration

Platform	Alder Lake, Cannon Lake, Coffee Lake, Comet Lake, Ice Lake, Jasper Lake, Rocket Lake, Tiger Lake, Whiskey Lake
Operating System	Windows* 10 x64 RS5/RS6/20H1/20H2
BIOS	Audio DSP enabled, HDA codec enabled, SoundWire* enabled, BT*/USB audio enabled

Intel® SST driver should be installed on systems with at least 1 GB of system memory. There should be enough hard disk space in the directory on the system in order to install this software.

Note: Contact the respective BIOS AE for BIOS specifications.

2.3 Intel® SST Mandatory BIOS Configuration

Enter BIOS by tapping F2 once the platform starts to boot.

For SST Enable

Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration

HD Audio = <Enabled>
Audio DSP = <Enabled>

Audio DSP Compliance Mode:

1. If DMIC is connected to PCH, select <Non-UAA (Intel® SST)>
2. If DMIC is connect to codec, select <UAA (HDA Inbox/Intel® SST)>

For Audio Codec Selection

Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration

HDA-Link Codec Select: Selecting “Platform Onboard” means that a single verb table is installed. On the other hand, selecting “External Codec” will use multiple verb tables. Depending on environment, select <Platform OnBoard> or <External Codec Kit>

For Audio Link Selection

Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration

Audio Link Mode: Depending on the required Audio link select <HD Audio Link> or <SSP (I2S)> or <SoundWire> or <Advanced Link Config>

If <Advanced Link Config> is selected, the setup is as follows:

HDA Link [ ]

DMIC #0 [X]

DMIC #1 [X]

SSP #0 [ ]

SSP #1 [ ]

SSP #1 [ ]

SSP #2 [ ]

SSP #3 [ ]

SSP #4 [ ]

SSP #5 [ ]

SNDW #1 [X]

SNDW #2 [X]

SNDW #3 [ ]

SNDW #4 [ ]

[X] – Enabled [ ] – Disabled

NOTES:

1. Enable or disable the required audio link from the menu above.
2. Enable the Audio Link in RVP by following the respective rework instructions.

For Post-Processing Selection

Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration

Audio DSP Pre/Post-Processing Module Support: Select corresponding post-processing effect in options.

If there is Custom Module to add, select Custom Module 'Alpha'/'Beta'/'Gamma' and input corresponding GUID of the IP. Also, corresponding GUID mapping needs to be added in Platform ACPI code.

Intel® Wake on Voice (Intel® WoV) Support for Personal Assistant (PA)

Intel® Wake on Voice (WoV) is running from Intel DSP, it could wake system up from Modern Standby (S0ix) or Ready Mode (S0 screen off). When system enters S0, Intel® WoV triggers personal assistant (PA).

Intel® WoV solution provides integrated solution that provides personalization and convenience. Intel® WoV running on DSP supports Microsoft* Windows* 10 RS5/RS6 Cortana* and Amazon* Alexa* as Hardware Keyword Spotter for keyword detection. Intel® WoV supports two PAs simultaneously running on the system configuration. PA selection could be Microsoft* Windows* 10 RS5/RS6/20H1/20H2 Cortana*, Amazon* Alexa*, or any new PA integrated with Intel® WoV.

- **Intel® Wake on Voice on DSP Support for RS5/RS6 Cortana* and Amazon* Alexa* Simultaneously:**

  To configure Intel® Wake on Voice support for Cortana* and Alexa* simultaneously, the following setup is needed:

  Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration

  WoV (BIT 0) = <TRUE>

  DSP based Speech Pre-Processing Disabled (BIT 7) = <TRUE>

  VAD API Mode (BIT 8) = <Windows 10 Voice Activation>

- **Intel® Wake on Voice on DSP Support for Two PAs Excluding Cortana*:**

  To support two PAs excluding Cortana*, the following setup is needed:

  Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration

  WoV (BIT 0) = <TRUE>

  DSP based Speech Pre-Processing Disabled (BIT 7) = <TRUE>

  VAD API Mode (BIT 8) = <Intel WOV>

- **Intel® Wake on Voice on DSP Support for 20H1 OS MVA:**

  To configure Intel® Wake on Voice support for MVA, the following setup is needed:

  Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration

  WoV (BIT 0) = <TRUE>

  DSP based Speech Pre-Processing Disabled (BIT 7) = <TRUE>

  VAD API Mode (BIT 8) = <Windows 10 Voice Activation>

Note: Refer to Section 5.8 for the remaining configuration for MVA.

- **Enable Intel® Wake on Voice module in pre/post-processing module list:**

  Enable the Intel® WoV pre-processing module in the Audio DSP Pre/Post-Processing Module list is needed as well.

  Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration

  WoV (BIT 0) = <TRUE>

  DSP based Speech Pre-Processing Disabled (BIT 7) = <FALSE>

NOTES:
1. For Modern Standby system, BIOS needs to add PEP constraint code to support Audio Controller being in D0:F1 state.

```
Package() {"\\_SB.PCI0.HDAS",0x1, Package() {0, Package() {0xFF,
0, 0x81}}},// 15 -cAVS(HDAudio)
```

2. Post-processing modules can be enabled together with Intel® WoV.
3. More than one post-processing modules can be enabled depending on the resources used by ISV. For Post-processing modules combinations, contact the ISV for more information.

CS/Non-CS Settings

Intel Advanced Menu/ACPI SETTINGS

Low Power S0 Idle Capability

a. If CS is supported, select <ENABLED>
b. If CS is not supported, select <DISABLED>

RTD3 Settings

Intel Advanced Menu/ACPI D3Cold Settings

ACPI D3Cold Support = <Enabled>

BT* Audio Offload Settings: (For ICL, CML v2 and TGL only)

Intel Advanced Menu/CNVi Configuration / ®Audio Offload

BT* audio offload mode support = <Enabled>

Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP NHLT Endpoints Configuration/Bluetooth*

BT* audio offload mode support = <Enabled>

Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP Feature Support

Bluetooth* Sideband [X]

BT* Intel HFP [X]

External NHLT Settings

Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP NHLT Endpoints Configuration/NHLT External Table

This is an optional setting that depends on which NHLT settings you would use for CML/ICL and later platforms:

1. Load the customized NHLT which is imported to BIOS by customer, enable < NHLT External Table>
2. Load default DMIC blob integrated in RVP, disable < NHLT External Table>

2.4 Action Required After Flashing BIOS/Change BIOS Settings

After flashing the new BIOS or changing ACPI table settings it is important to perform the following sequence:

1. Boot to Windows* 10.
2. Perform system reboot.
3. After reboot, perform system shutdown.

The above sequence is important to ensure that Windows* 10 reloads and uses the ACPI tables provided by a new BIOS.

S4 (hibernation) is a normal shutdown state for Windows* 10. While walking from S4 state Windows* reloads the ACPI tables from disk (hibernation file).

If BIOS is changed, ACPI tables generated by the previous BIOS version are still stored in the hibernation file on a disk. Windows* restart ensures usage of ACPI tables generated by the current BIOS. A subsequent shutdown stores these new ACPI tables in hibernation file.

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3 NHLT and DMIC Blob Integration

3.1 Introduction

NHLT (Non-HD-Audio Link Table) is defined as an ACPI Data consisting of the standard ACPI Header and information about non-HD Audio endpoints supported by the system. NHLT Generator in IADK provides graphical configurator of endpoints and generates NHLT binary file.

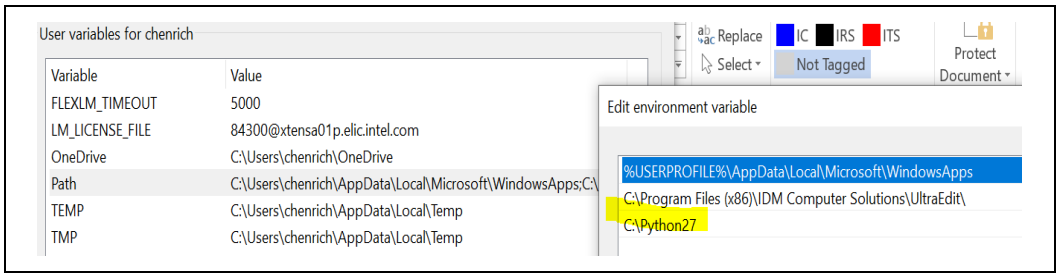
To integrate the generated NHLT/DMIC blob file into BIOS, refer to BIOS guidance in Ref003 for BIOS integration.

Note: The USB audio offload feature is supported on the TGL by default, so it does not require configuration in NHLT.

3.2 Pre-Installed Libraries

3.2.1 Python* 2.7

%PATH% environment is set to include Python* 2.7 directory.



3.2.2 wxPython* 3.x

Download from the following path: https://www.wxpython.org/download.php#msw

3.2.3 OpenSSL

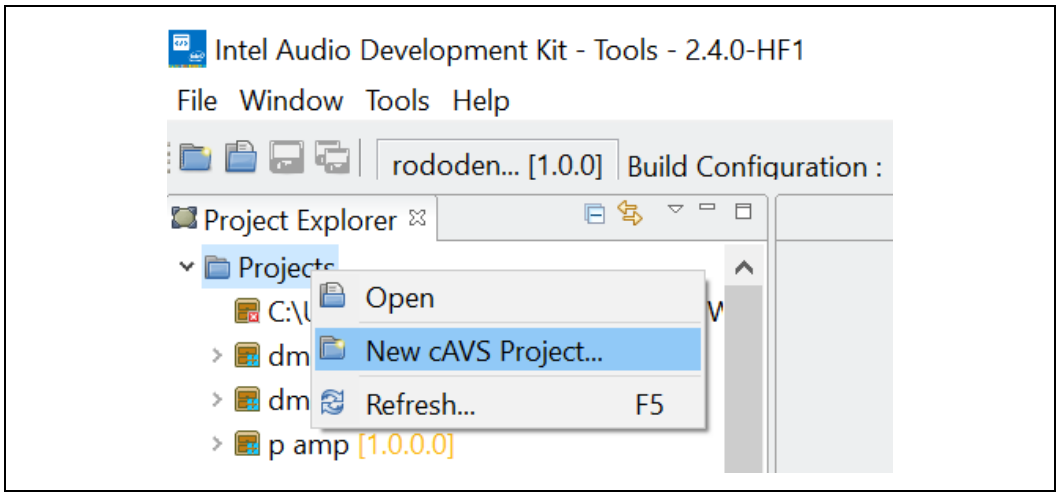
Ensure that the installation path: "openssl.exe" is under the path
C:\GnuWin32\bin\openssl.exe

Note: For example, Installed python-2.7.13.amd64.msi/wxPython3.0-win64-3.0.2.0-py27.exe/openssl-0.9.8h-1-setup.exe

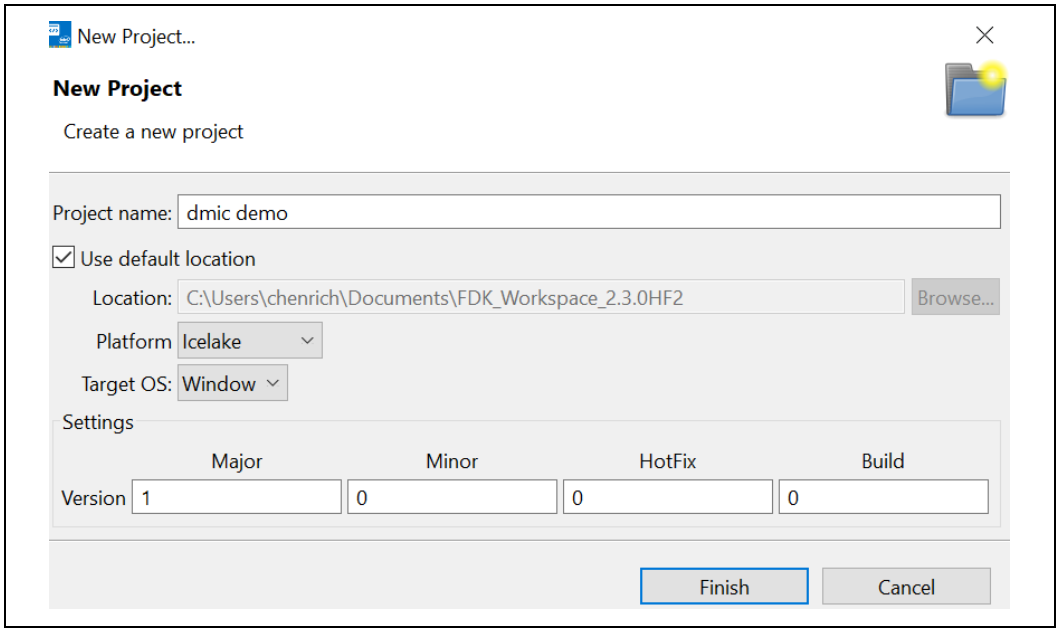
3.3 How to Generate nhlt.bin for DMIC

3.3.1 IADK Usage Step by Step

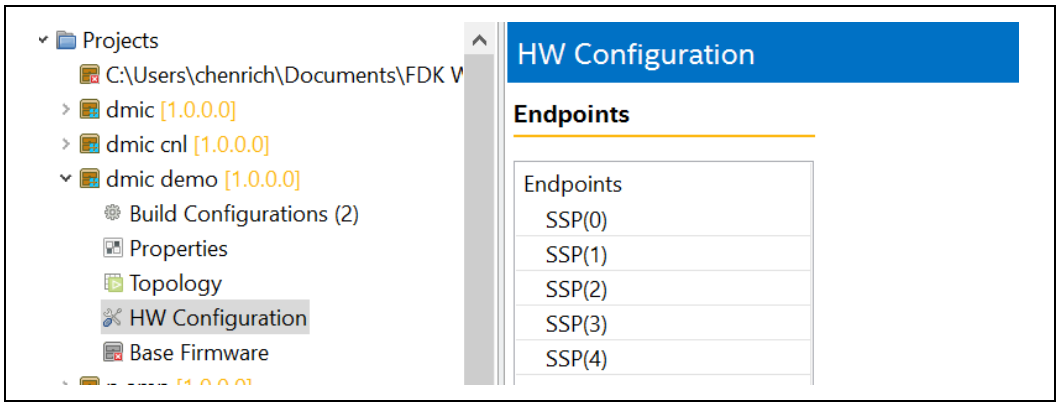
1. Install **IADK**. NHLT generation is supported after IADK 2.5 MR1. Versions equal or higher would support the same functions.
2. Right click **Project** and select **New Cavs Project.**



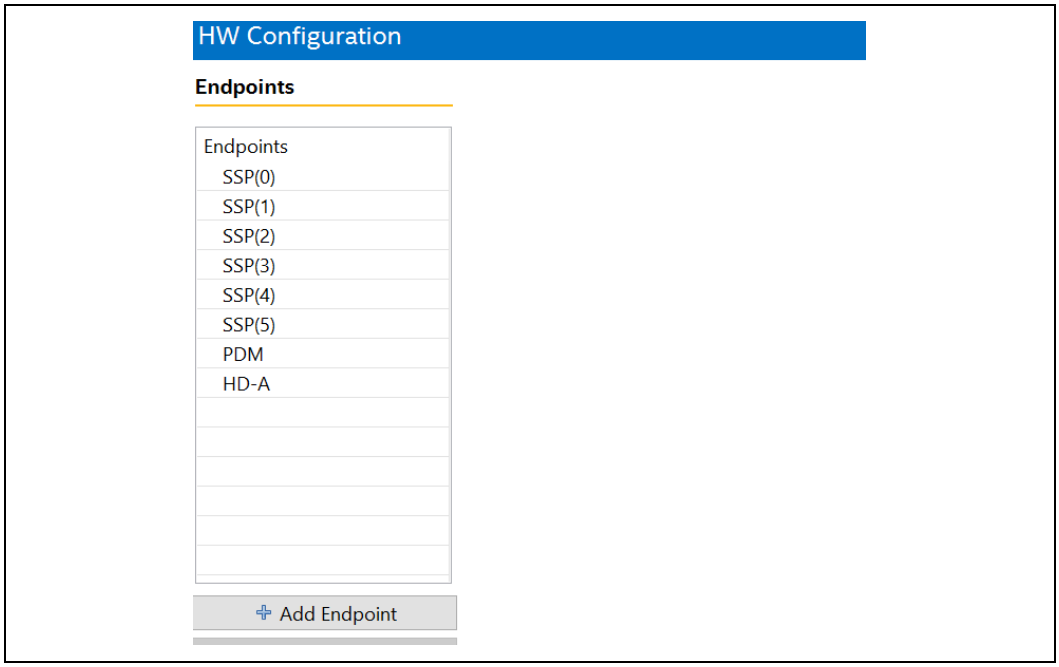
3. Fill the fields:
   a. **Project Name** and **Version**.
   b. Choose correct **Platform**.
   c. Select **Target OS** according to target project platform.

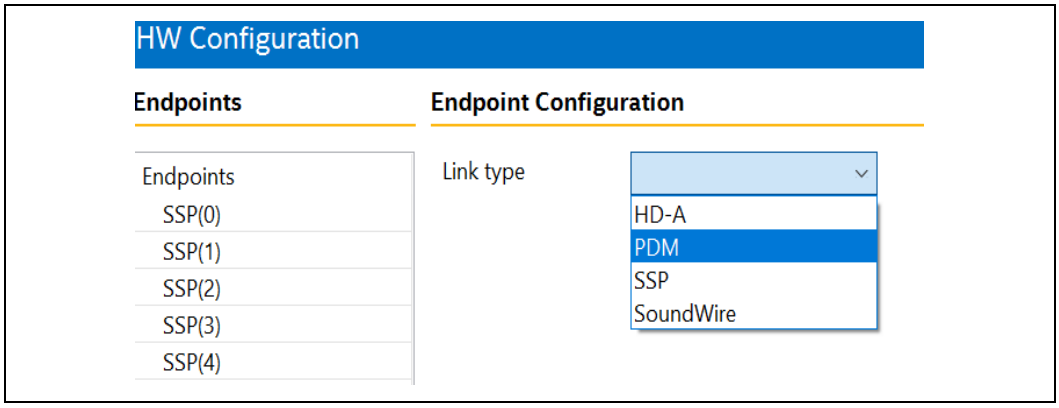


4. Select **Project created** and double click **HW Configuration**.



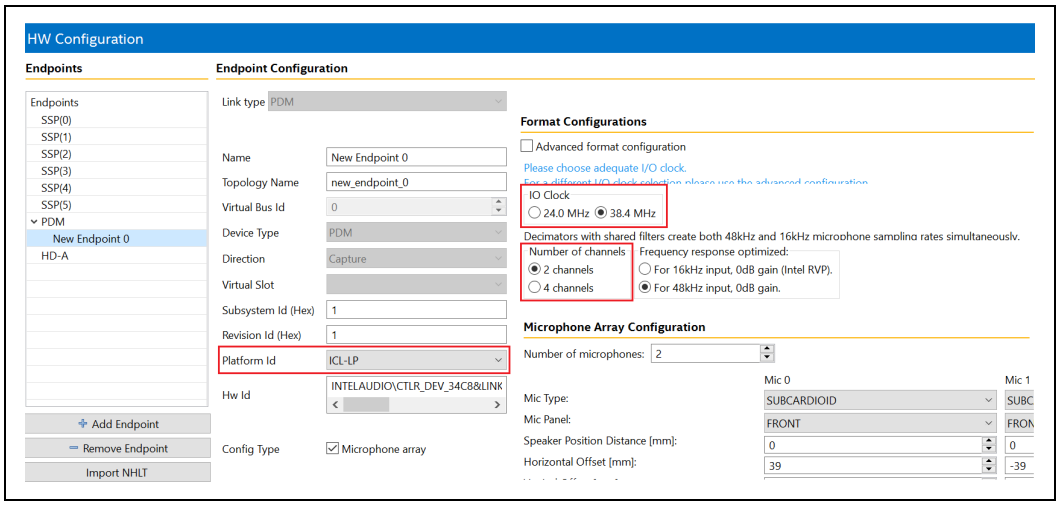
5. Click **Add Endpoint** to create new endpoint.
   a. Choose the preferred link type.
   b. To create configuration for DMIC connecting to PCH, choose Endpoint as **PDM**.
   c. Select **Link type** as **PDM**.





6. Configure the following information according to the target project configurations:
   a. **Platform ID:** The PCH ID according to target project SoC PCH info.
   b. **I/O Clock:** The PCH XTAL output clock.
      Refer to platform PDG or PCH EDS to get PCH XTAL clock.
      Confirm with account platform CE and HW CE if not clear about the previous two configurations.
   c. **Number of channels:** The number of MIC channel on the target project.

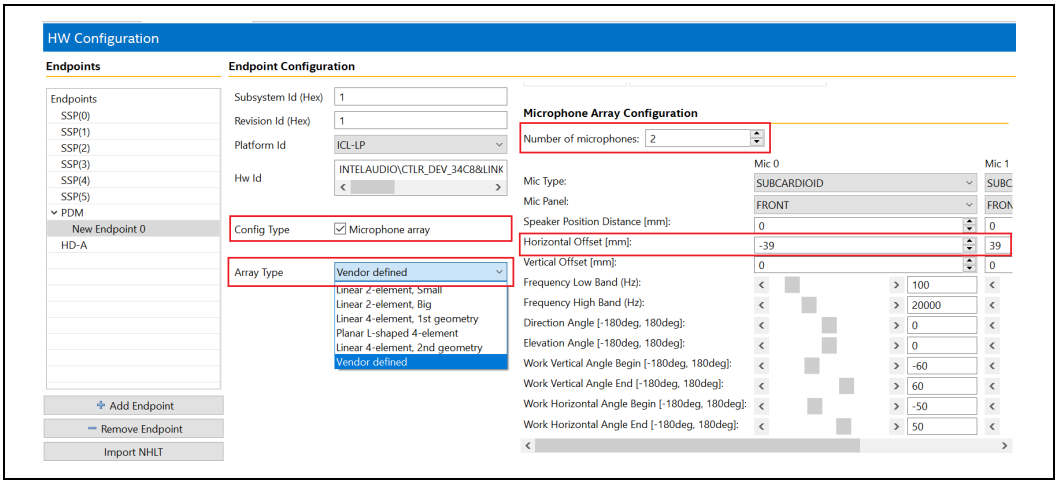
Note: If there are three microphones attached, two on PDM0 and one on PDM1, then you must choose four channels in **Number of channels** configuration.



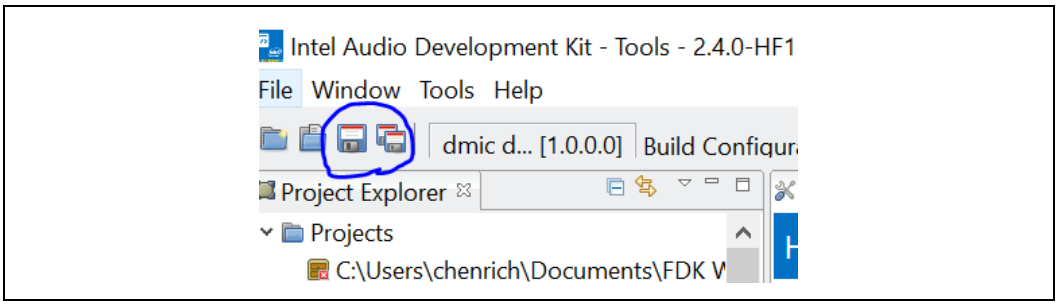
7. Microphone array and geometry configuration.
   a. **Config Type:** choose if **Microphone array** is in use on the target project. **Microphone array** checkbox activates the following array type configuration.
      i. **Array Type:** choose if the Microphone array placement matches one of the pre-defined geometry configurations or choose **Vendor defined** to customize your own.
      ii. **Number of microphones:** Choose the microphone number on **MIC array**.
      iii. **Horizontal Offset(mm):** Put the distance offset of microphone components.

Note: If microphone placement is horizontal linear then put the distance offset of microphone component to the center of the device as plus-minus millimeter values. Or pick the leftmost microphone as 0 position and add the offset of the remaining microphones.

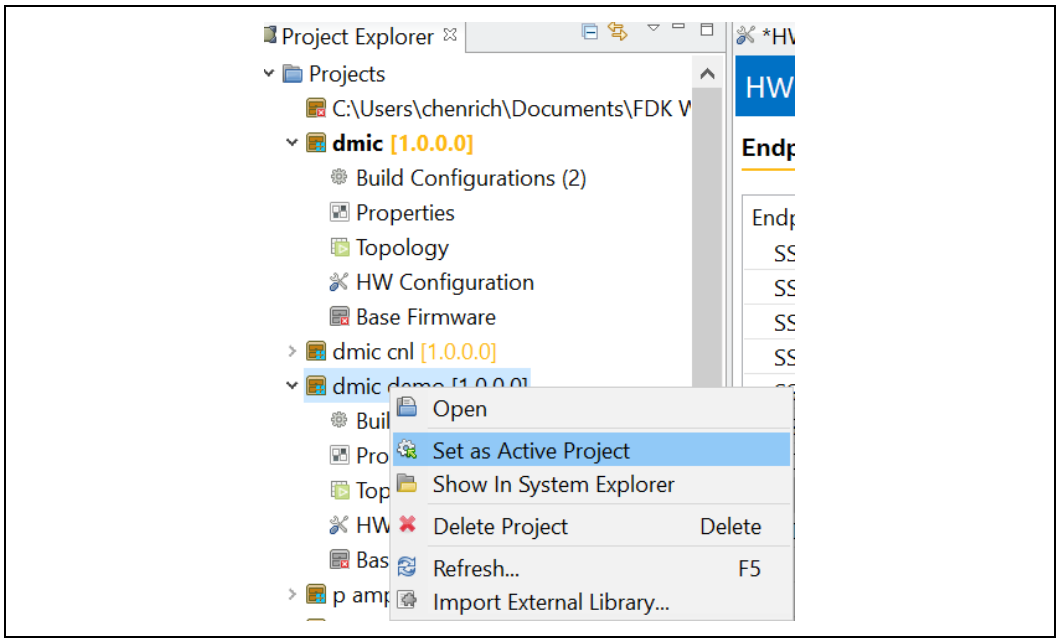
For further details to define Microphone Array Geometry Descriptor Format, refer to Ref004.



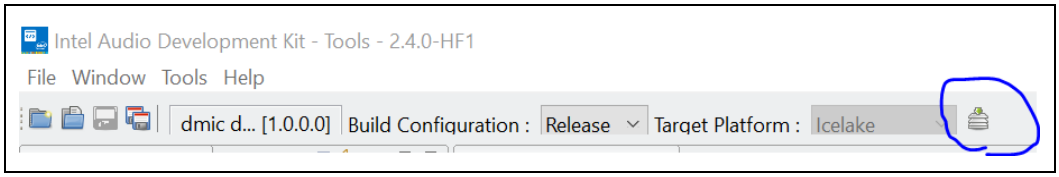
8. Click **Save** to retain settings in the hwconfigurtion.xml file in the following location: FDK_Workspace/name_project/metadata.

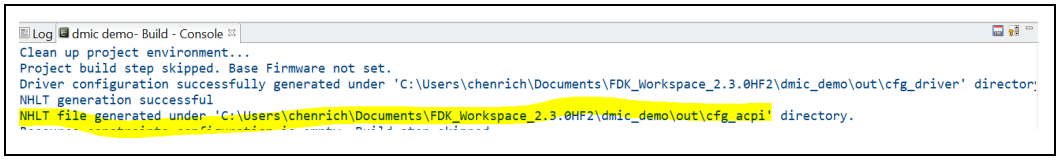


9. Set the created project as **Active Project** if the project is inactive.



10. Build the project to generate **nhlt.bin** file. The nhlt.bin file will be in the path **FDK_Workspace/name_project/out/cfg_acpi**





3.3.2 How to Verify nhlt.bin

After generating the nhlt.bin file, verify the bin file to target device, and check DMIC CLK on the device.

1. Copy **nhlt.bin** file to device, path:
   C:\windows\system32\cAVS\nhlt_FILE_NAME.bin
2. Add registry key to override the value.
   [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\IntcOED\Parameters]
3. "NhltOverridePath"="\SystemRoot\System32\cAVS\nhlt_FILE_NAME.bin"
   Reboot system
4. Measure DMIC CLK and check signal.

If the microphone is working as expected, then the nhlt.bin file is ready for BIOS integration. Need to integrate the generated NHLT/DMIC blob file into BIOS, refer to BIOS guidance in Ref003 for BIOS integration. Contact the BIOS CE if any assistance is required.

3.4 How to Generate nhlt.bin for BT* Offload

Note: For ICL, CML v2 and TGL only

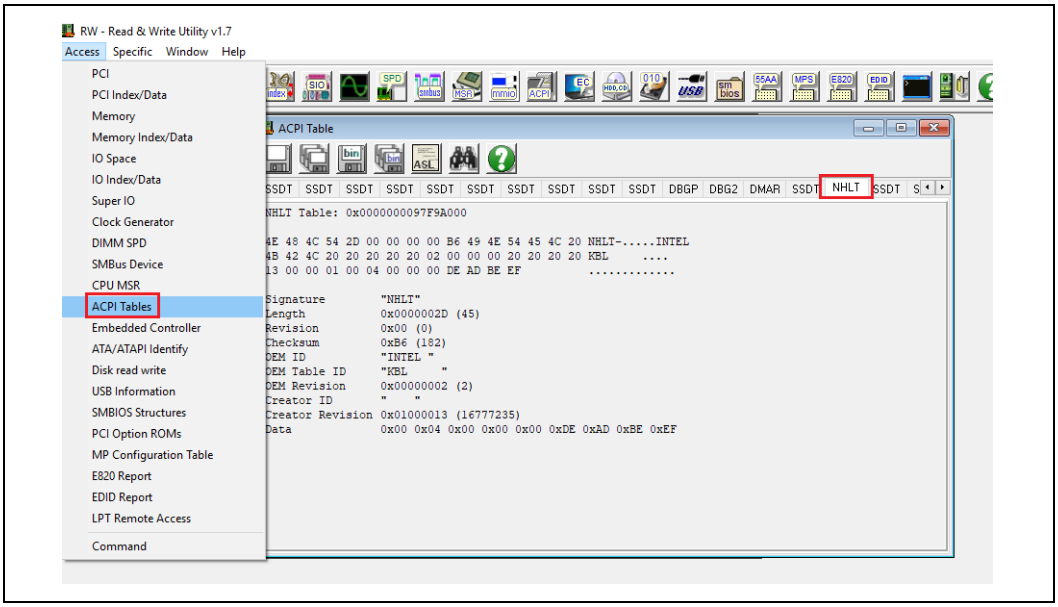
The default BT* audio settings are integrated into Intel RVP BIOS, and it should be suitable for most of BT* headset device in our experience. Add your customized PDM (DMIC configuration) into the default nhlt.bin file from RVP.

The default NHLT from RVP is available in the following Bring Up Guide files:

- CML v2
- ICL
- TGL

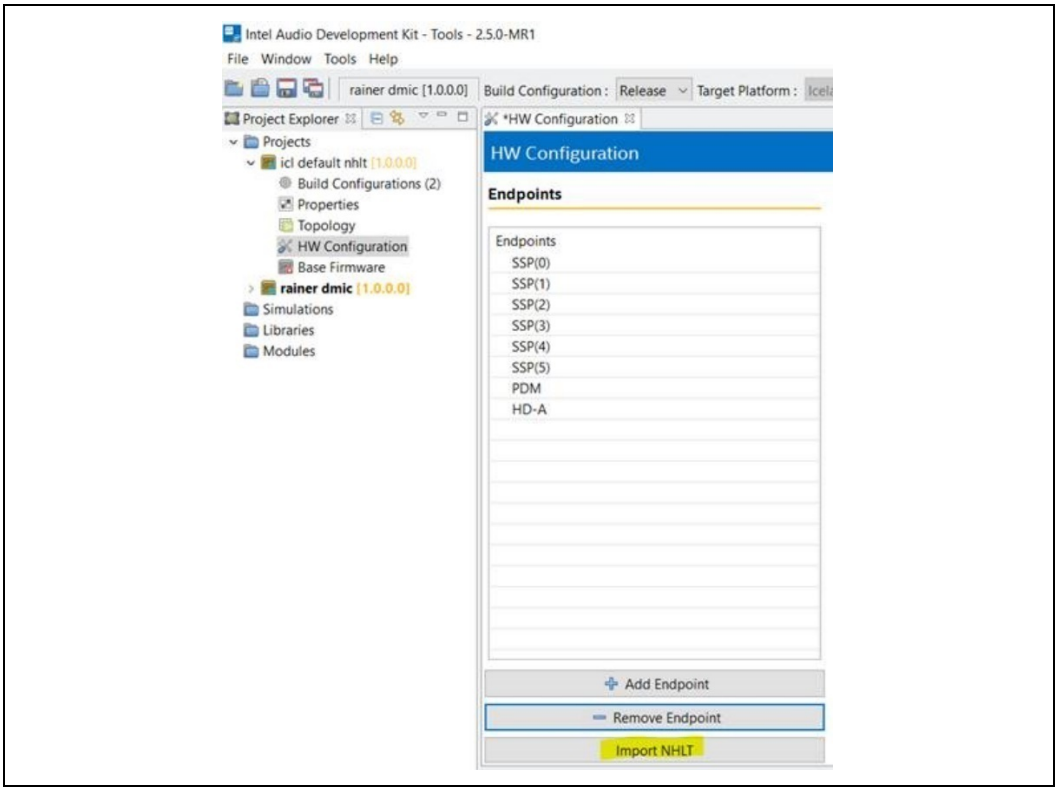
3.4.1 IADK Usage Step by Step

1. Retrieve the default nhlt.bin file.
   The method to retrieve the default nhlt.bin:
   a. Use internal **NHLT**
   b. **Boot** into OS
   c. Dump nhlt.bin from device via RW

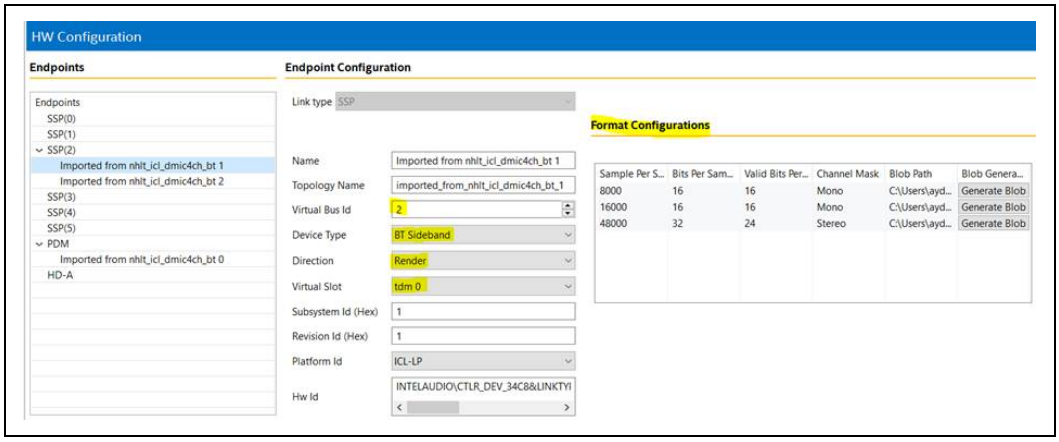


Note: Configuration may change on different platforms.

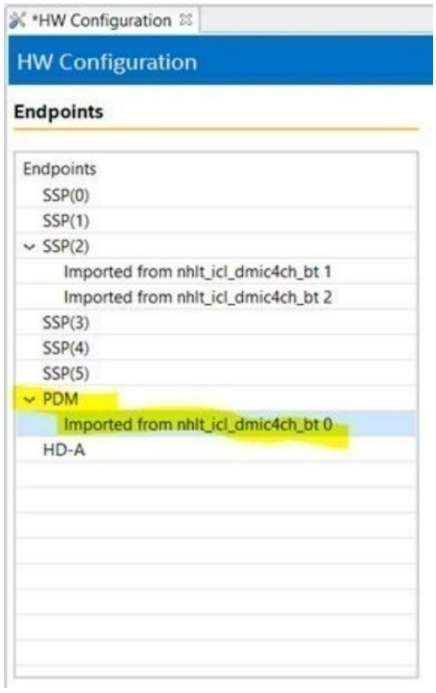
2. Integrate DMIC configuration into default nhlt.bin
   a. Create a **New project** in IADK.
   b. Import the retrieved nhlt.bin from the previous step.



c. BT* configuration is for both render and capture and are included after nhlt.bin imported.



d. For PDM (DMIC configuration), refer to steps in previous Section 3.3.1 to fit the DMIC design.



e. Follow the steps mentioned in Section 3.3.2 to verify BT* offload function and integrate into BIOS.

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4 Driver/Application Installation

Ensure BIOS settings are configured before Intel® SST Driver installation.

The following procedure to install the Intel® SST Driver is required.

4.1 Driver Installation

Use the "Have Disk…" method to install the following drivers.

Browse to the unzipped Platform Milestone release folder location (for example, Intel® _Smart_Sound_Technology_<Platform>_<Milestone>_Release_vx.xx.xx.xxx\) and perform the following step:

1. Install BUS driver (IntcAudioBus.inf) from the subfolder Drivers over High Definition Audio Controller in the Device Manager.
   a. Name of the device before installing driver: High Definition Audio Controller.
   b. Name of the device after installing the driver: Intel® Smart Sound Technology (Intel® SST) Audio Controller.

2. Install OED driver (IntcOED.inf) from the subfolder Drivers over Intel High Definition DSP in the Device Manager.
   a. Name of the device before installing driver: Intel High Definition DSP.
   b. Name of the device after installing the driver: Intel® Smart Sound Technology (Intel® SST) OED.

Optional step only if DMIC is connected to PCH

3. Install DMIC driver (IntcDMic.inf) from the subfolder Drivers over Digital microphone device in the Device Manager
   a. Name of the device before installing driver: Digital Microphone Device.
   b. Name of the device after installing the driver: Intel® Smart Sound Technology (Intel® SST).

Optional step only if SDW interface enable instead of HD audio:

4. Install SDW driver (IntcSDW.inf) from the subfolder Drivers over SDW master device in the Device Manager.
   a. Name of the device before installing driver: SoundWire* device.
   b. Name of the device after installing driver: Intel® Smart Sound Technology (Intel® SST).

Optional step only for Bluetooth* audio offload enabling (For ICL, CML v2 and TGL only)

5. Install Bluetooth* Audio driver (IntcBtAu.inf) from the subfolder Drivers over Bluetooth* device in Device Manager.
   a. Name of the device before installing driver: There is no Bluetooth* device under Intel® Smart Sound Technology (Intel® SST) OED
   b. Name of the device after installing the driver: Intel® Smart Sound Technology (Intel® SST).

Optional step only for USB audio offload enabling (for TGL only)

6. Install UAOL driver (IntcUSB.inf) from the subfolder Drivers over UAOL device in Device Manager.
   a. Name of the device before installing driver: There is no USB device under Intel® Smart Sound Technology (Intel(R) SST) OED.
   b. Name of the device after installing the driver: Intel®) Smart Sound Technology (Intel® SST).

NOTES:

1. For QS samples, install ProductionFW driver. For ES samples, install the NonProductionFW driver. Otherwise, Yellow Band will be seen on OED device.
2. Install the appropriate Intel® SST driver based on the platform that the drivers are being installed on (for example, ICL Intel® SST drivers in ICL platforms).
3. For TGL system installed with 20H1 OS, install GFX driver before SST driver because GFX will enable SGPC (Shared Graphics Power Component). Otherwise there will be non-SGPC HDA hidden device in the Device Manager.

4.1.1 Checking the Driver Version

To check the Intel® SST Driver version:

1. Open the **Device Manager**.
2. Click **Sound, Video, and Game controllers** arrow to open the list of audio/sound devices.
3. Double click the device named as **Intel® Smart Sound Technology**.
4. Select **Driver** tab and verify that the **Intel® SST** driver version is correct
5. Double click **HW Audio Codec** device
6. Select **Driver** tab and verify that the Codec driver version is correct

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5 Basic Audio DSP Features Check

5.1 Playback on System Pin

1. Prepare .wav sound file (for example 24bit, 48khz, stereo)
2. Open Windows* Media Player
3. Select and play the .wav sound file
4. Check if the sound is audible
5. Try **different sound file extensions (.mp3, .aac**).

5.2 Intel® WoV with Cortana*

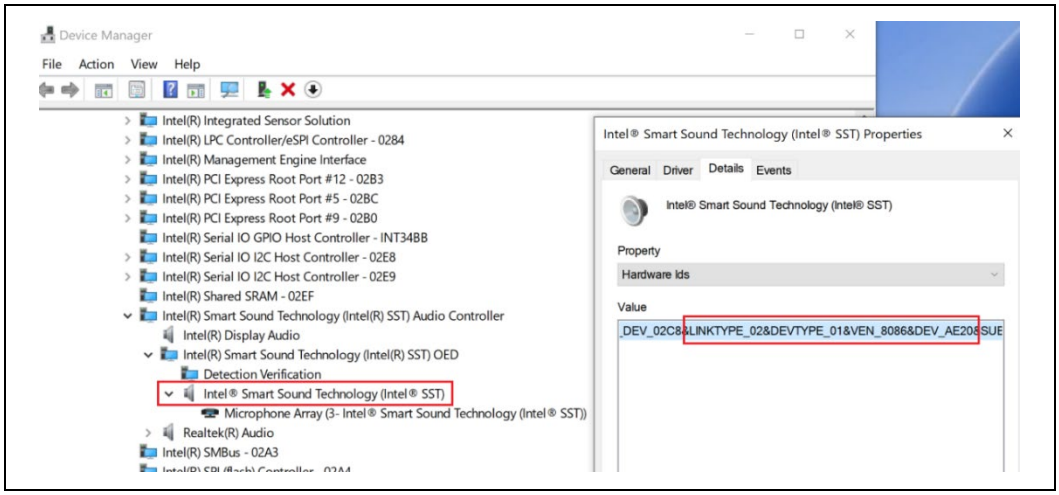
1. Go to Cortana* Settings and turn on the options:
   a. 'Let Cortana* respond to "Hey Cortana"'.
   b. 'Use Cortana* even when my device is locked.'
2. Let system enter Connected Standby mode.
3. Check if system wakes up when called "**Hey Cortana**".

5.3 Playback on Offload Pin

1. Prepare .wav sound file (for example 24bit, 48khz, stereo)
2. Open Windows* 10 **Groove Music**.
3. Select and play the .wav sound file
4. Check if the sound is hearable
5. Try **different sound file extensions (.mp3, .aac)**.

5.4 Recording Volume on DMIC to PCH

1. Open Windows*10 **Voice Recorder**.
2. Click **Record** button and start to record.
3. Open **Recording** page in **Sound** from the speaker icon in right-down corner.
4. Try to adjust the volume bar to check recording volume.
5. Check if recording volume take effect as expectation or not.
6. Check the description of HWID in properties page of Device Manger as well. The full string of DMIC PDM endpoint descriptor is as shown below,
   a. **LINKTYPE_02&DEVTYPE_00&DEV_AE20 || LINKTYPE_02&DEVTYPE_01&DEV_AE20** (DEVTYPE_01 is required due to old BIOS RC code compatibility, but BIOS RC code may change to 00 in the future)

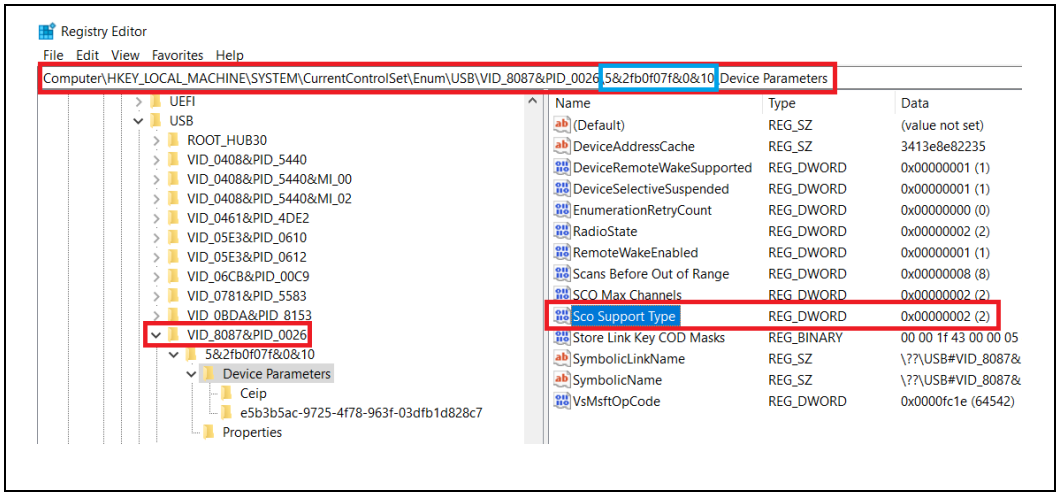


Note: Since Intel DMIC driver does not provide analog AGC when DMIC is connected to PCH, you will requried 3rd party SW APO to support SW gain control for volume adjustment.

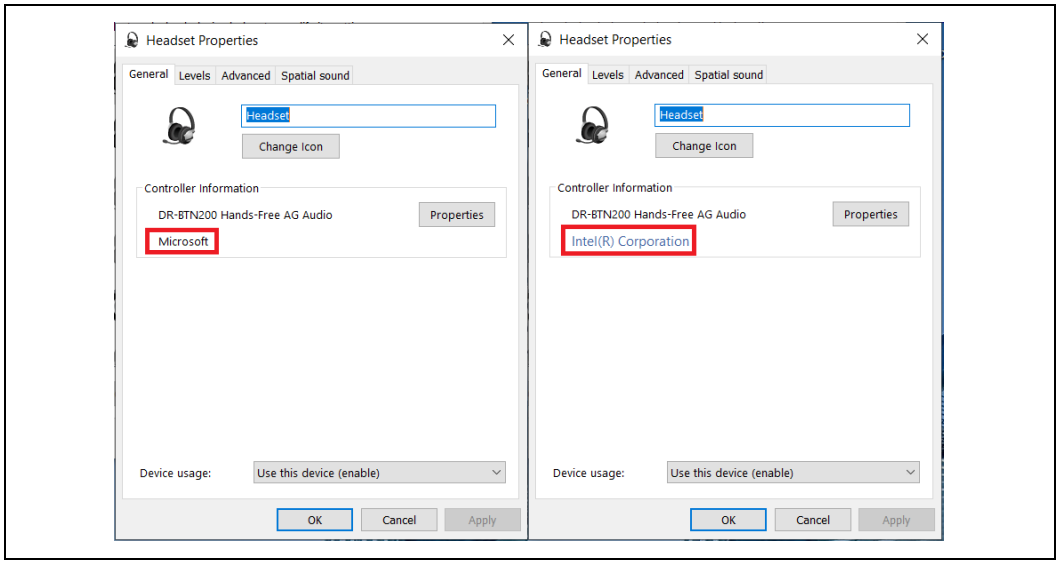
5.5 Bluetooth* Audio on Offload Pin

Note: For ICL, CML v2 and TGL only. Refer to **Ref002** – "Bluetooth* Audio Offload Technical Advisory" for more details.

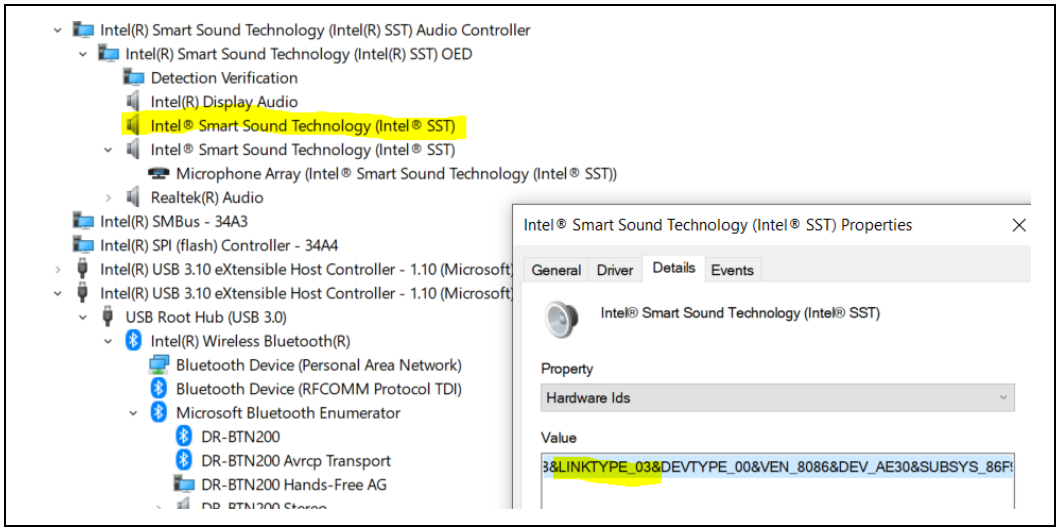
1. Contact BIOS member to ensure GPIOs for BT* Offload (**GPPC_A_7** and **GPPC_A_10)** are configured as **GPIO mode**.
2. Follow Section 2.3 to configurate BT* Audio offload in BIOS.
3. For audio device setup
   a. Pair with Bluetooth* Headset.
   b. Go to **Playback** tab in **Sound**.
   c. Verify that the Bluetooth* Headset (Hands-Free) is available.
4. BT* driver will query the BIOS and write into the registry with the appropriate audio offload support value:
   a. [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Enum\USB\VID_<VID> &PID_<PID>\<DEV_ID>\Device Parameters]
      i. If BT* Audio Offload is to be disable, "Sco Support Type" <0x0>
      ii. If BT* Audio Offload is to be enable, "Sco Support Type" <0x2>



5. Check the **Controller information** from **Sound** > **Playback** > **Headset Properties**, and check if **Intel® Corporation** (Refer to right side of the figure shown below) if it is running on the offload pin.



6. Since the BT* Audio link is not standard HD audio, there are necessary configurations in NHLT as described in Section 3.4. An extra Intel® SST child device would be under Intel OED if right NHLT integrated into BIOS as shown in figure below.
7. Check the description of HWID in properties page of Device Manger as well. The full string of BT* Endpoint Descriptor is as below,
   a. LINKTYPE_03&DEVTYPE_00&DEV_AE30



5.6 USB Audio Offload

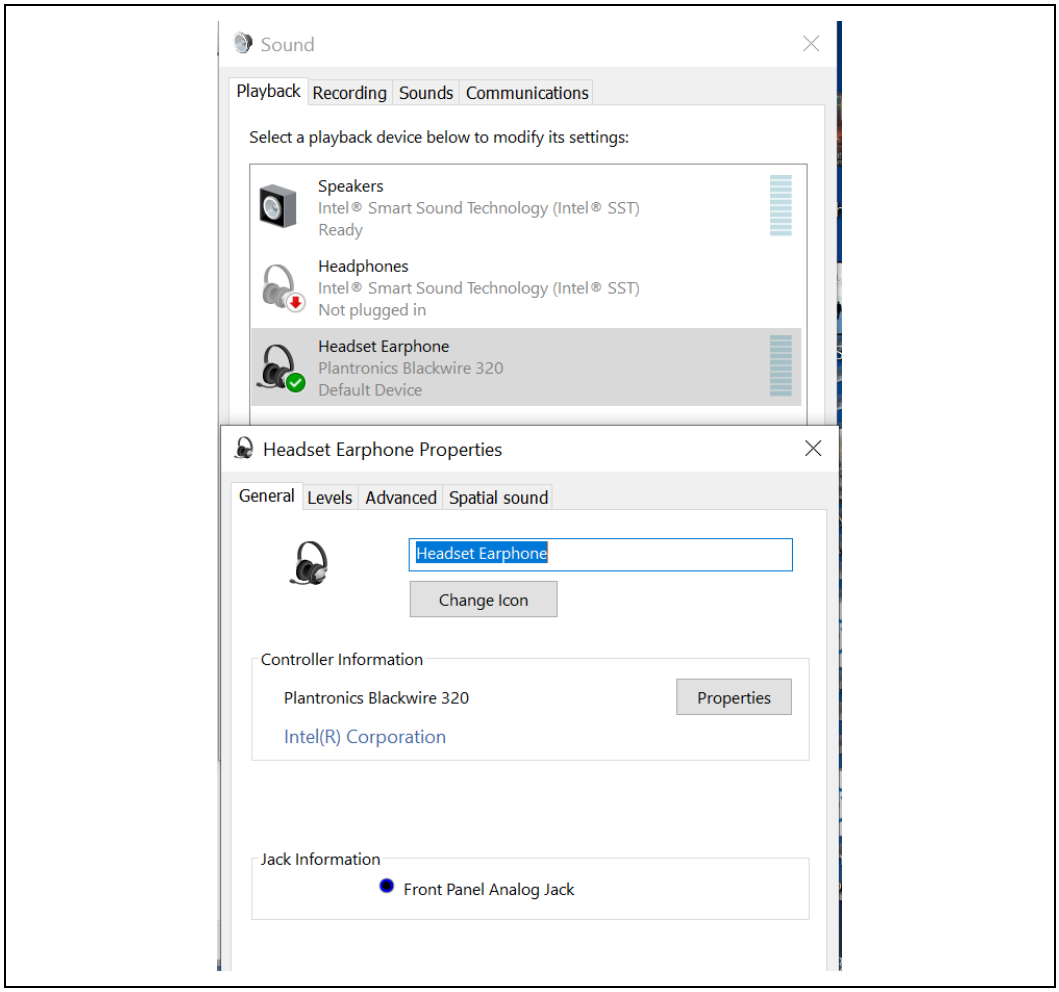
Note: For TGL only. Refer to **Ref012** – "USB Audio Offload Technical Advisory" for more details.

USB audio offload is supported only on **UAC 1.0 device**s, and not on UAC 2.0 or other devices. Customers can use USB View tool from Microsoft* WDK to determine the type of USB device (UAC 1.0 or UAC 2.0) connected to the system.

By default, USB Audio is offloaded to DSP if followed TGL BKC. contact BIOS member to follow RVP BIOS reference code for USB audio offload enabling. Additionally, BIOS must set **HCCPARAMS2.GSPC** on 1 (When GSPC is 0, then MSFT inbox driver will not expose interface to OED and IntcUSB will not be enumerated).

Refer to items below to check UAOL enable successfully or not.

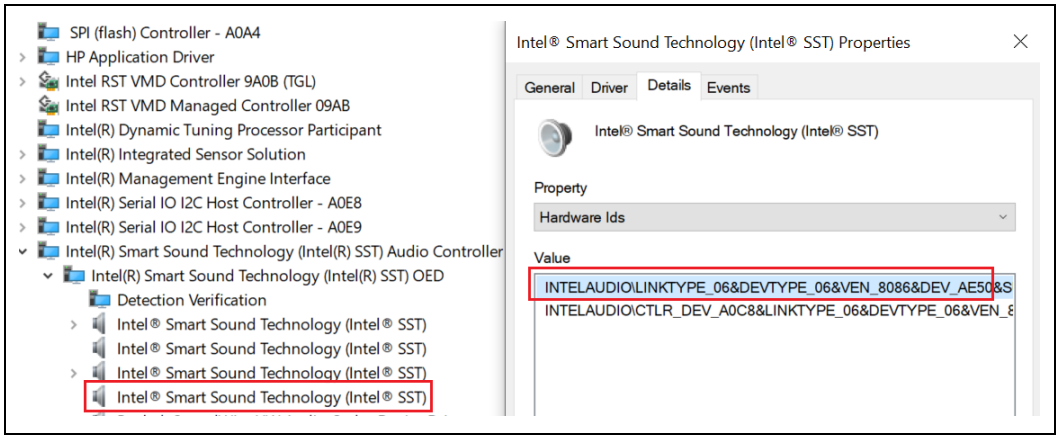
1. After the driver of UAOL installed, check the **Controller information** from **Sound** > **Playback** > **Headset Properties**, and check **Intel® Corporation** if it is running on USB audio offload pin.

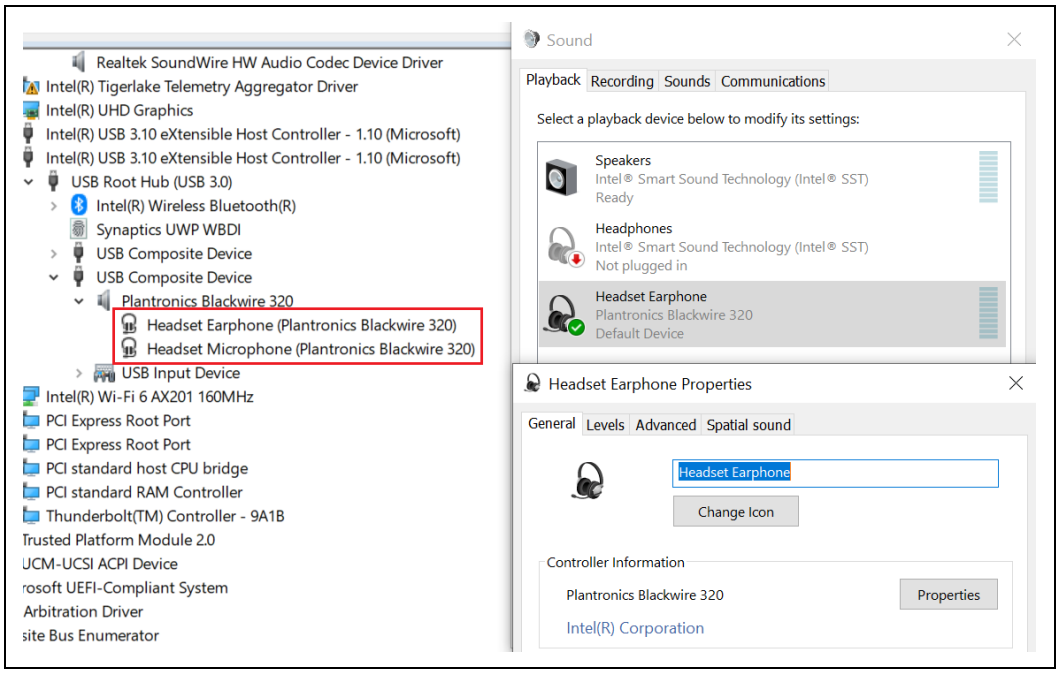


2. Check if the USB headset device is as child device of Intel® SST OED.

Note: USB headset endpoints will still appear under xHCI in the device manager. Check the description of HWID in properties page of the Device Manger as well. The full string of USB Audio device descriptor is as shown below:

   a. LINKTYPE_06&DEVTYPE_06&DEV_AE50

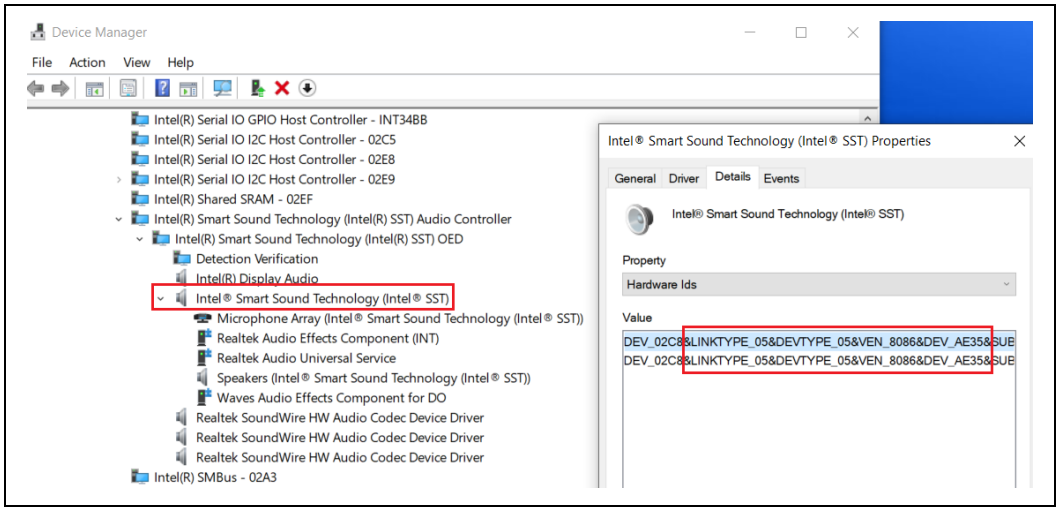




5.7 SoundWire* Audio Device

In SDW design, there is one SDW audio device as a child device under Intel OED after driver of IntcSDW is installed. Check the description of HWID in properties page of Device Manger as well. The full string of SDW endpoint descriptor is as below,

1. **LINKTYPE_05&DEVTYPE_05&DEV_AE35**



5.8 Multi-Voice Assistant

Note: For TGL only. Refer to **Ref006** – "MVA enabling guidance" for more details. MVA extension inf is certified standalone without SST driver binaries. MVA extension inf and SST driver binaries are separate links in Microsoft partner web site and needs to be resold separately. MVA extension version matches the DetectionVerificationDrv version.

For Multi-Voice Assistant enabling, configurations in BIOS, MVAExtension.Inf and Windows* settings are required.

1. **BIOS**

   Follow Section 2.3 to configurate BIOS, Set **VAD API Mode** as **Windows* 10 Voice Activation**

Intel Advanced Menu → PCH-IO Configuration → HD Audio Configuration → HD Audio DSP Features Configuration

- WoV (BIT 0) = [TRUE]
- DSP based Speech Pre-Processing Disabled (BIT 7) = [TRUE]
- VAD API Mode (BIT 8) = [Windows 10 Voice Activation]

2. **MVA Extension Inf**

   Define configuration of VAs for a given design in **IntelMvaExtension.inf**

```
; Default placed in VALocaleMap registry key. By default, Alexa and Cortana supported in all locales
[IntelMva.EnableMva_Default]
HKR,VALocaleMap,VAEventIDs,0x00010000,%HeyCortanaEventGuid%,%AlexaEventGuid%

; OEM DLL will read VALocaleMap to determine what VAs to support based on current system locale.
; China Chinese (Simplified) (0804) only supports Cortana and Xiaowei
; VAEventIDs value will be place in locale language id subkey: VALocaleMap\0804.
[IntelMva.EnableMva_zh-CN]
HKR,VALocaleMap\zh-CN,VAEventIDs,0x00010000,%HeyCortanaEventGuid%,%XiaoweiEventGuid%
```

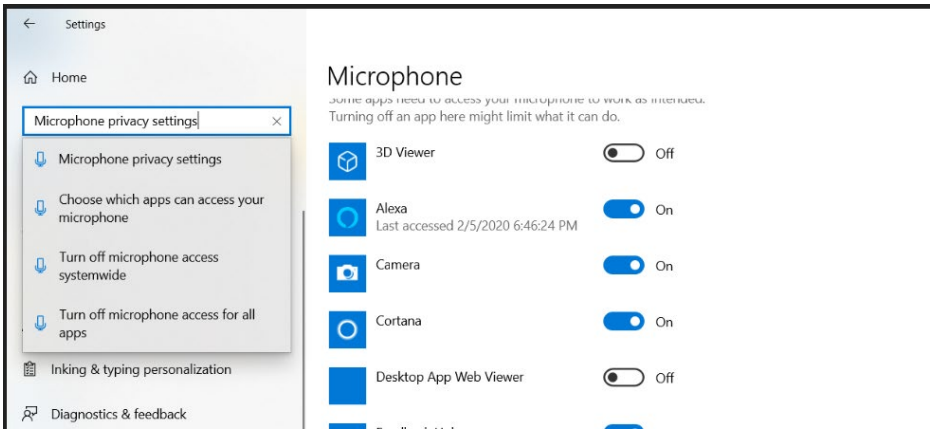
Check the MVA extension installation and version by command with Administrator right "**dism /Online /Get-Drivers /Format:table |findstr mva**".

```
PS D:\> dism /Online /Get-Drivers /Format:table |findstr mva
oem17.inf | intelmvaextension.inf | ? | Extension | Intel(R) Corporation | 2020/12/3 | 1.0.1785.0
PS D:\>
```

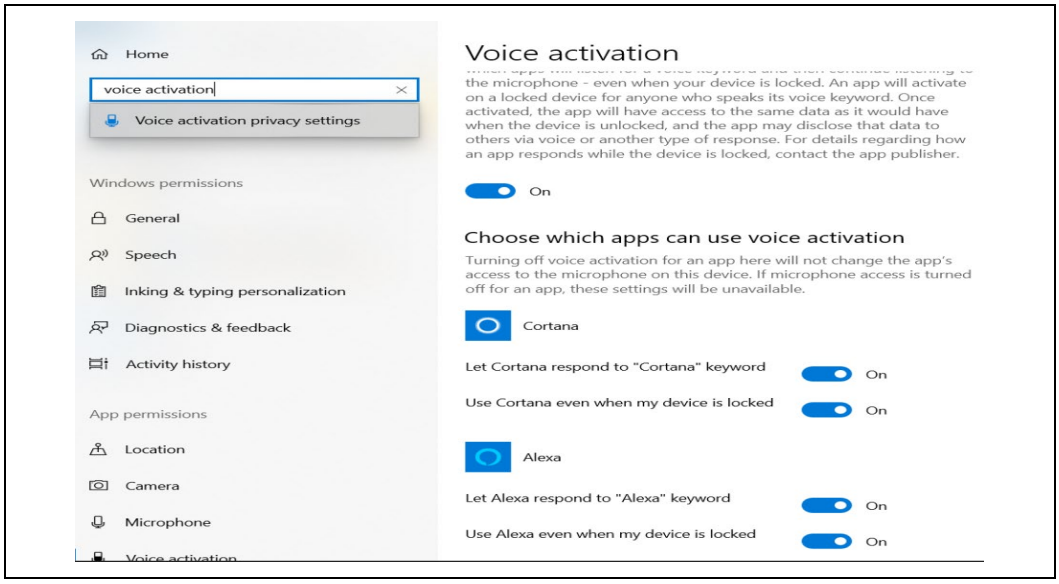
3. Windows* Settings

Turn on VAs access right to **Microphone** and **Voice Activation**, Enable capture audio enhancements.

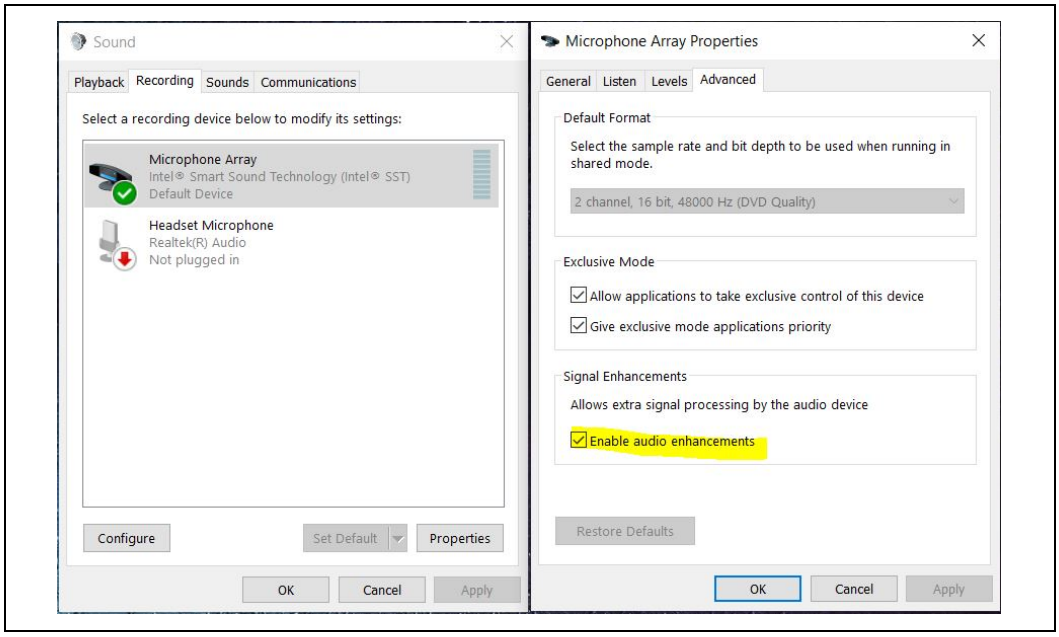
a. Turn on VAs access to **Microphone**



b. Turn on VAs access to **Voice Activation**



c. Select **Sound** Control Panel > **Recording** > **Microphone Array** > **Properties** > **Advanced**, and check **Enable audio enhancements** checkbox**.**



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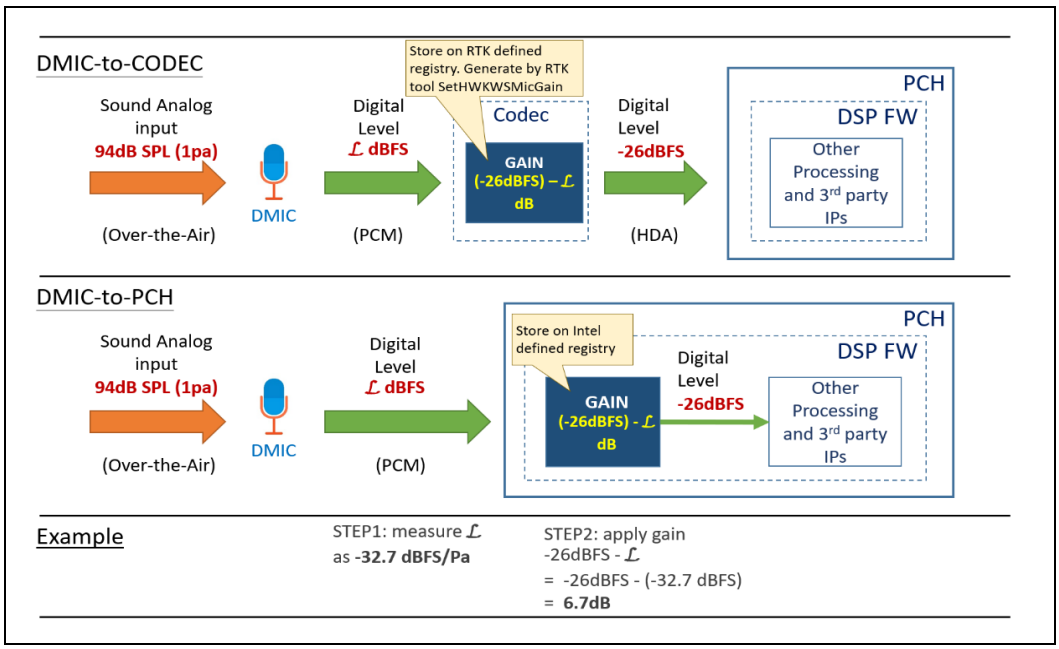
6 -26dBFS MIC Sensitivity Calibration

6.1 -26dBFS Introduction

The -26dBFS/Pa calibration process is to let the system have -26dBFS/Pa input sensitivity. To achieve it, we need to add a proper gain on DSP (for DMIC-to-PCH) or codec (for DMIC-to-Codec) designs.

It can be separated into DMIC-to-PCH and DMIC-to-Codec cases. Refer an example:



6.2 Intel® SPET and MIC Sensitivity Calibration Tool

Intel® SPET Tool and Documents: (contact Intel Audio CE to enable access and get latest SPET download link)

- Intel® SPET v1.0.2474.0
  https://platformsw.intel.com/CollateralDownload.aspx?key=COL.1025986
- Intel® SPET v1.0.2582.0
  https://platformsw.intel.com/ddrivers.aspx?kitnumber=1000547
- Intel® SPET Plugin:
  https://platformsw.intel.com/CollateralDownload.aspx?key=COL.1024447

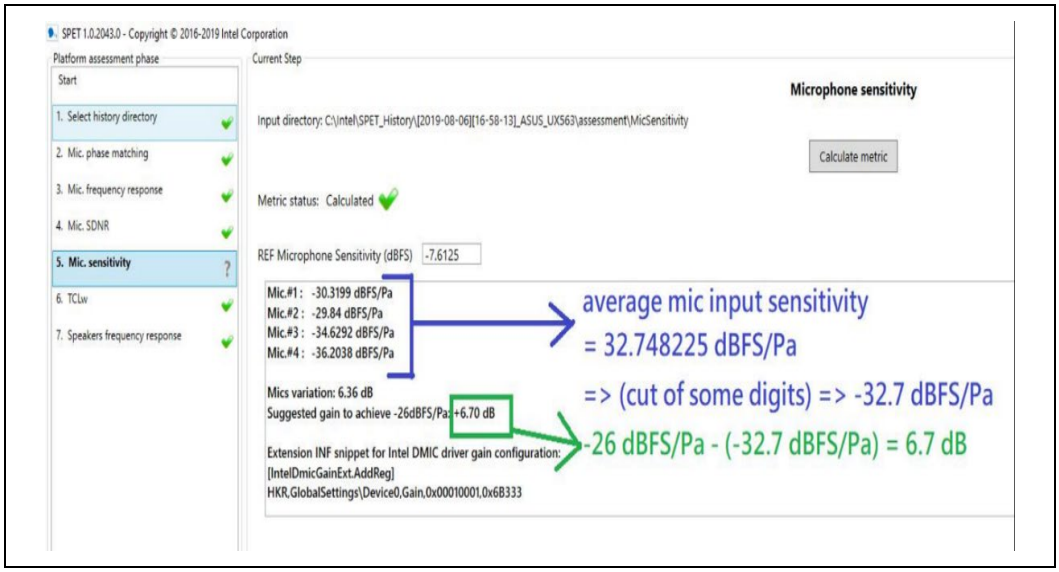
- Intel® Speech Platform Evaluation Toolset Test Guide
  https://cdrdv2.intel.com/v1/dl/getContent/595819

For DMIC-to-Codec cases, contact RTK to get the gain adjust tool-SetHWKWSMicGain.

6.3 MIC Sensitivity Calibration Process

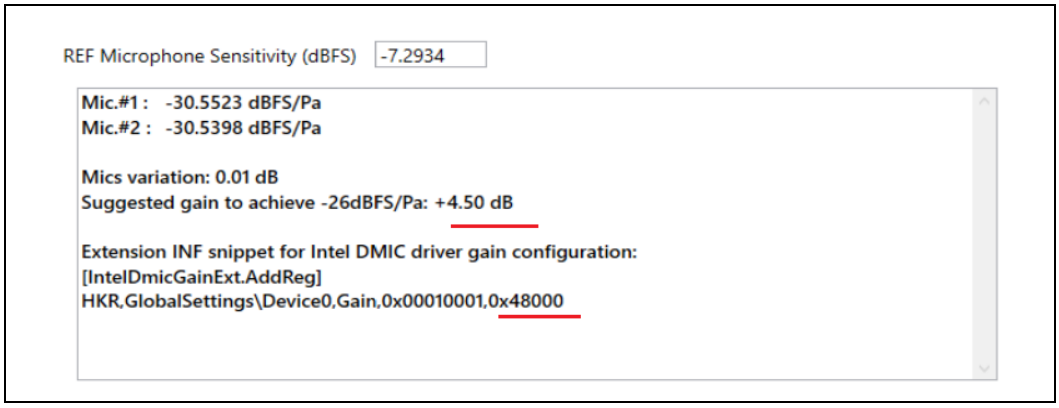
1. Follow 595819-intel-spet-test-guide to setup Intel® SPET lab, or run by PAL lab.
2. Run Intel® SPET, make sure it passes phase, frequency response, SDNR, sensitivity, TCLw.

The Intel® SPET's microphone sensitivity page show the suggested gain to compensate.



6.4 DMIC-to-PCH Design Calibrate MIC Sensitivity

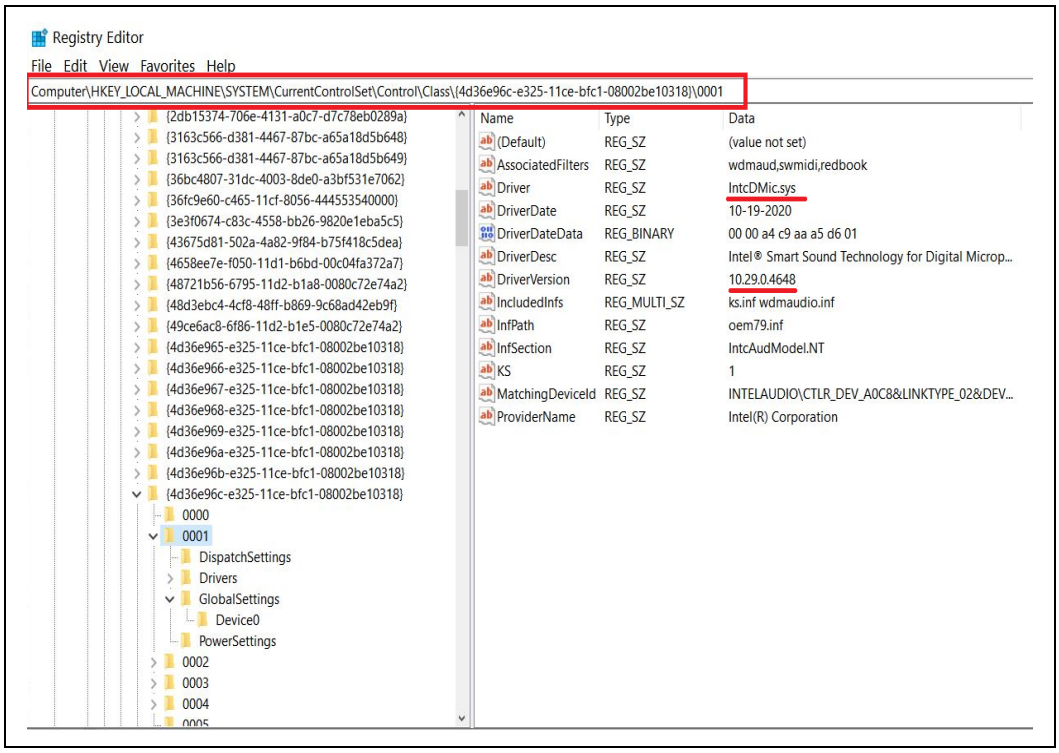
1. Get the suggested gain from the Intel® SPET MIC sensitivity test page



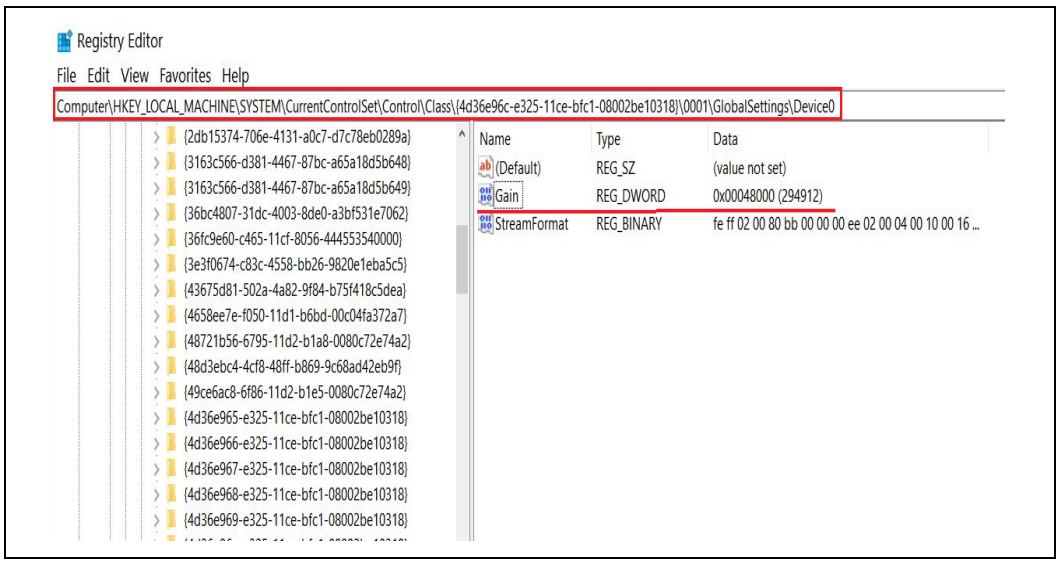
2. Set the gain to DMIC in registry table

*[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Class\{4d36e96c-e325-11ce-bfc1-08002be10318}\<**instance**>\GlobalSettings\Device0]*

3. Make sure the <instance> is IntcDMic.sys



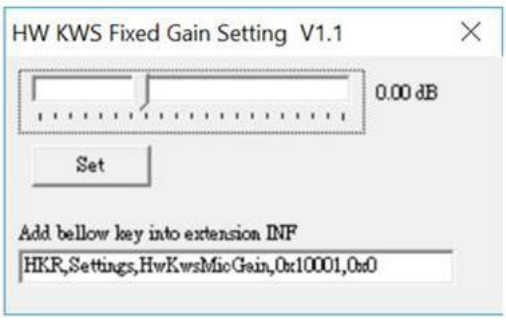
4. Set the Gain with DWORD type to registry.



5. Re-test Intel® SPET and make sure MIC sensitivity setting take effect.
6. Integrate the registry setting in audio installation package at production stage.

6.5 DMIC-to-Codec Design Calibrate Gain

At tuning stage, use RTK tool - SetHWKWSMicGain to set the gain



At production stage, write gain into RTK defined registry.

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7 Intel® SST Driver from Inbox Driver on System that is Not Audio DSP Enabled

The newest proposal between Microsoft* and Intel assures and enables customers to keep UAA compliant hardware IDs while still supporting the Intel® SST driver stack.

Systems that use the HD-A interface are recognized to be UAA compliant. Refer below for the proposals:

- **Microsoft* Inbox HD-A Bus Driver**
  - Match on PCI\CC_0403
  - Child PnP IDs are "HDAUDIO\..."
- **Intel HD-A Bus Driver**
  - Match on PCI\VEN_8086&DEV_1324&CC_040301
  - Match on PCI\VEN_8086&DEV_1234&CC_040100
  - Child PnP IDs are "INTELAUDIO\..."

As such:

Class	Subclass	Programming Interface	Drivers Supported
04	03	**00**	Microsoft* Bus Driver [1] (Windows* 7+)
04	03	**80**	Microsoft* Bus Driver [1] (Windows* 7+) Intel® SST Bus Driver (Windows* 8+)
04	**01**	00	Intel® SST Bus Driver (Windows* 8+)

Note: Platform configuration must be UAA compliant (example, DMIC must attach to codec, I2S) for Microsoft* bus driver support.

- **Row1 with class code 040300:** Legacy systems that support the Microsoft* Inbox Bus driver that is UAA compliant. This value is required to be used on the non-SST systems with DMIC attached to the HD-A Codec.
- **Row2 with class code 040380:** This value is required to be used on SST enabled systems with DMIC attached to HD-A Codec.
- **Row3 with class code 040100:** This is for systems where the DMIC is attached to the PCH via the PDM interface thus deeming it to be a non UAA compliant system.

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